



WATER PURIFICATION

Subject: Science | Current: 2010 | Grade: 9-12

Day: 3 of 3

1 Purpose

To analyze the effectiveness of the water purification systems in providing safe drinking water.

2 Duration

50 Minutes

3 Additional Topics

Water Pollution, Natural Disasters, and Health Issues

4 Objectives

At the conclusion of this lesson, students will be able to:

- Determine the effectiveness of the water purification systems created in lesson 2.
- Test the presence of contaminants in water samples
- Revise original emergency plan created in lesson 1.

5 Standards Addressed

SCIENCE

ENVIRONMENTAL SCIENCE

Understand and describe if a disaster occurs – such as flood or fire – the damaged ecosystem is likely to recover in stages that eventually result in a system similar to the original one.

ENV.1.2

Recognize and explain the amount of life any environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms.

ENV.1.14



Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people.

ENV.1.33

EARTH AND SPACE SCIENCE

Investigate the causes of severe weather and propose appropriate safety measures that can be taken in the event of severe weather.

ES.1.16

HEALTH & WELLNESS

Examine how the environment and health are connected.

HW.1.3

Indiana Department of Education. (n.d.). Indiana Standards and Resources: Sciences: Environmental Science and Earth Space Science; Health & Wellness. Retrieved from <http://dc.doe.in.gov/Standards/AcademicStandards/StandardSearch.aspx>

6

Vocabulary

----- These terms are included in the lesson plan:

- **pH:** Used to express the acidity or alkalinity of a solution on a scale of 0-14.
- **Nitrates:** A salt of nitric acid commonly found in fertilizers.
- **Heavy Metals:** Aluminum, copper, lead, arsenic...
- **Free Chlorine:** A form of chlorine that kills bacteria, algae, and disease-causing organisms.
- **Sulfate:** A salt of sulfuric
- **Hardness:** The measure of ions present in the water.
- **Alkalinity:** The ability of a solution to neutralize acids.

7

Materials

----- Materials to aide the lesson plan include:

- Water Testing Kits – URL at end of lesson plan.
- Water sample to be purified by students' water purifying systems
- Water Testing Lab Worksheet
- Water Purification Project Rubric



8 Methods & Procedures

----- The lesson plan's course is as follows:

A. Introduction

Having safe drinking water in the event of a natural disaster is essential to surviving the storm; however, how is it possible to know whether or not the drinking water is safe to drink? Drinkable water cannot be determined by simply looking at the water, but rather additional testing must be performed in order to determine the true quality of the water.

In the case of a natural disaster emergency, water-testing kits would probably not be available; therefore, the quality of water is assumed to be safe after being processed through the water purification system. To ensure the safety of the water, the best strategy is to perform tests on samples of it for such contaminants as nitrates, chlorine, lead, copper, and aluminum. The health threats each of these contaminants pose to individuals ranges from weight loss to cancers; therefore, it is imperative to test the water in our homes even after the storm waters have receded.

B. Development

After the introduction, each group will obtain a water sample to test the effectiveness of the water purification system created in Lesson 2. Students need to make observations about the water and predict:

- What are the possible contaminants present in the water system?
- Which steps in the water purification system will eliminate each of the contaminants?

C. Independent Practice

Students will get into their previous groups and test the effectiveness of the water purification systems created in Lesson 2. While waiting for results, students need to consider the following questions:

- Is the water purification system working? Why or why not?
- What step in the water purifying system is not functioning properly?
- What changes can be made to the system to ensure it will function properly?

As soon as water filters through the water purifier, students need to obtain it and move on to the next step.



D. Practice

Once water has passed through the water purification kits, students need to obtain a water testing kit to test the water sample for nitrates, pH, free chlorine, heavy metals, and alkalinity. Directions for each water sampling will be provided in the water sampling kits.

- Record results of each test on the lab worksheet.
- In which of the following water tests was the water purification system successful?
- Which tests resulted in positive results for the contaminants?
- What changes need to occur to the water purification kit to ensure negative results in the contaminants? Are those proposed changes practical in the event of an emergency?
- Revise the emergency plans created in Lesson 1 based on knowledge learned over the course of the past 3 lessons.

E. Accommodations (Differentiated Instruction)

For students who have difficulty handling the testing equipment, lab probes may be used for reading the pH and other information directly from the sample. Struggling students may need a flow chart to assist them in determining the steps they must take to gather data and make revisions.

F. Checking for Understanding

- Students will be asked to explain the effectiveness of the water purifier.
- Students will be asked to propose changes to the water purification system and emergency plan based on results of water tests.
- Students will be asked to identify contaminants remaining in the water based on water testing results.
- Students will be asked to analyze water-testing results.



G. Closure

Careers Involved in Water Purification:

- U.S Geological Survey or Agricultural Research Service - URL at end of lesson plan.
- U.S. Bureau of Reclamation – URL at end of lesson plan.
- Bureau of Land Management – URL at end of lesson plan.
- U.S. Army Corps of Engineers – URL at end of lesson plan.
- U.S. Forest Service – URL at end of lesson plan.
- Natural Resources Conservation Services – URL at end of lesson plan.
- U.S. Environmental Protection Agency – URL at end of lesson plan.

10 Evaluation

Students will be evaluated on their water purification model, revised emergency plan, and water testing lab results via Water Purification Project Rubric.

11 Teacher Reflection

To be completed by teacher following the lesson.



12 Media & Resources

----- Websites and Video provided throughout lesson plan:

- http://wardsci.com/product.asp_Q_pn_E_IG0003048_A_name_E_WaterWorks%26trade%3B+School+Test+Kit
- Water sample to be purified by students' water purifying systems
- Water Testing Lab Worksheet
- Water Purification Project Rubric
- U.S Geological Survey or Agricultural Research Service – <http://www.usgs.gov>
- U.S. Bureau of Reclamation – <http://www.usbr.gov/>
- Bureau of Land Management – <http://www.blm.gov/>
- U.S. Army Corps of Engineers – <http://www.usace.army.mil/>
- U.S. Forest Service – <http://www.fs.fed.us/>
- Natural Resources Conservation Services – <http://www.nrcs.usda.gov/>
- U.S. Environmental Protection Agency – <http://www.epa.gov/>
- http://www.theoutdoorlodge.com/survival/preparedness_guide/chapter_5.html
- www.survivaloutdoorskills.com/

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WATER TESTING LAB WORKSHEET

After completing each test below, record results in the table and answer the following discussion questions.

TEST	RESULTS
[pH]	
Nitrates	
Free Chlorine	
Lead	
Copper	
Hardness	
Alkalinity	

1. Which tests resulted in a positive outcome?
2. Which tests resulted in a negative outcome?
3. Which steps of the water purification system could have possible failed due to the results of the water tests?
4. What could have been done differently to affect the end results?
5. Are the changes proposed to the water purifying process feasible in the event of a natural disaster?
6. Based on the information gathered during the past three lessons, how would you revise your emergency plan and survival kits to ensure you and your group members would have safe water?



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WATER TESTING LAB WORKSHEET

	Excellent 10 pts	Good 7 pts	Fair 4 pts	Poor 1 pt
Emergency Plan & Kit	Well-devised and thoughtful emergency plan including all of the practical necessities in case of a natural disaster.	Mostly well-devised and thoughtful emergency plan including most of the practical necessities in case of a natural disaster.	Somewhat thoughtful emergency plan including some of the practical necessities in case of a natural disaster.	Poorly devised emergency plan lacking many of the practical necessities in case of a natural disaster
Water Purifier Model	Creative and practical use for water purification process. Very effective in removing all contaminants.	Mostly creative and practical use for water purification process. Removed most of the contaminants.	Somewhat creative and practical model for water purification process. Removed some of the contaminants.	Lacked creativity and practicality for water purification process. Did not remove any of the contaminants.
Water Testing Lab	Performed water testing lab accurately.	Performed water-testing lab with some accuracy.	Performed water-testing lab with little accuracy	Failed to follow directions in the water-testing lab.
Water Purifier Revisions	Thoughtful revisions to modify water purifier.	Most revisions were thoughtful to modify water purifier.	Revisions were somewhat useful to modify water purifier.	Revisions would not modify water purifier to be effective.
Water Testing Lab	Group worked very well together in creating a well-thought out plan.	Group worked together most of the time.	Group worked together some of the time.	Group failed to work together to create an overall successful plan.

TOTAL POINTS: _____